National Climatic Data Center

DATA DOCUMENTATION

FOR

REANALYSIS DATA SETS

TD6160 - TD6170

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National Climatic Data Center
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1. **Data Set ID:**

TD6162

2. **Data Set Name**:

NMC Reanalysis Variety Physical Diagnostics Mostly SFC

3. **Data Set Aliases:**

none

4. **Access Method and Sort for Archived Data:**

WGRIB is a program written in the C language. A listing of WGRIB may be found in Appendix W of this document. The following paragraphs are provided from documents for general information only. For more in-depth discussion and to download a copy of WGRIB, users should point their browsers to the following location:

http://wesley.wwb.noaa.gov/WGRIB.html

What is GRIB?

GRIB is a WMO format for gridded data. GRIB is used by the operational meteorological centers for storage and the exchange of gridded fields. GRIB's major advantages are files are typically 1/2 to 1/3 of the size of normal binary files (floats), the fields are self describing, and GRIB is an open, international standard.

Advantages of a GRIB file.

A major advantage of GRIB is that is self describing. Each record has information such as: resolution of the grid, time, variable, level, who created the field. There are a number of programs to create GRIB inventories and WGRIB works well. This program was written in C and works on all reasonable machines ranging from PCs to CRAYs. Once you've installed WGRIB, an inventory is a single command line away.

How do I Read GRIB?

While there are a number of GRIB decoders available, WGRIB is the decoder most often used. Once you've installed WGRIB, decoding GRIB takes a single command line. The output from WGRIB can then be read by FORTRAN, C or even BASIC programs. The GRIB format may look complicated but reading GRIB is painless. You should never have to ask, "How do I read this data?".

How do I Display GRIB Files?

GrADS supports GRIB files and is very versatile. Some people have even stopped writing FORTRAN code and do their computations using GrADS. The demonstration program on the BAMS cd-rom (March 1996) is a sample of GrADS' abilities. GrADS will run under MS-DOS and on many UNIX boxes. Very powerful, freely available. and highly recommended.

In addition to GrADS, other programs such as Gempack or IDL can either directly or indirectly use GRIB data.

Comments

One's first impulse is to convert the GRIB file into some "understandable" format. It is better to extract the desired data and leave it in GRIB. This extraction can take as little as one command line using WGRIB. Keep the data in GRIB until you need it immediately. The advantages are that it saves disk space (who has enough disk space?), it is self documenting (what is record 33?) and is machine independent. This is similar to using "compressed" files. You don't need to know the format of a compressed file except that you can easily uncompress it, and you only uncompress the data
just before use.

WGRIB v1.6.0 by Wesley Ebisuzaki

Portable GRIB decoder

"WGRIB" is a portable program to read GRIB files that were created by the NCEP/NCAR Reanalysis Project.

The documentation for WGRIB is spread over several files, readme, readme.dos, formats.txt, GRIB2ieee.txt, notice, porting.txt, tricks.WGRIB and usertables.txt and changes.

Running WGRIB without any arguments displays a short help message.

```
Portable GRIB decoder for NCEP Operations etc.

v1.6.0 prelim 2 (7-01-97) Wesley Ebisuzaki
usage: ./WGRIB [GRIB file] [options]
```

Inventory/diagnostic output selection

```
-s/-v/-V  short inventory/verbose inventory/very verbose non-inventory
        (default) regular inventory

Options for inventory/diagnostic output
        -PDS/-PDS10/-GDS/-GDS10      print PDS/GDS in hex/dec
        -verf                        print forecast verification time
        -4yr/-ncep_opn/-ncep_rean    see documentation

Decoding GRIB selection
        -d [record number]  dump record number
        -p [byte position]  dump record at byte position
        -i                  dump controlled by stdin (inventory list)
        (none)              no decode .. inventory only
Options for decoding GRIB
        -text/-ieee/-bin/-GRIB  dump to a text/ieee/bin/GRIB file
        -h/-nh                  dump will have headers (default)/no headers
        -H                      dump will include PDS and GDS
                                (-bin/-ieee only)
        -append                 append to dump file
        -o [file]               output file name, 'dump' is default
```

***** Standard Inventory *****

WGRIB's first duty is create an inventory. This inventory also serves as an index file. Using the test file land.grb you should be able to enter:

```
% WGRIB land.grb
Using NCEP reanalysis table, see -ncep_opn, -ncep_rean options
1:0:d=87010100:LAND:kpds5=81:kpds6=1:kpds7=0:TR=0:P1=0:P2=0:TimeU=1:sfc:anl:N
Ave=1
```

The first line indicates that WGRIB couldn't figure out whether to use the reanalysis or operational GRIB tables. Since land.grb is from reanalysis, we should use the reanalysis tables. Trying again, we get

```
% WGRIB land.grb -ncep_rean
1:0:d=87010100:LAND:kpds5=81:kpds6=1:kpds7=0:TR=0:P1=0:P2=0:TimeU=1:sfc:anl:N
Ave=1
```

The inventory consists of several fields separated by colons. The contents of the fields are:

1. Record number
2. Position in bytes
3. Date (YYMMDDHH).
4. Parameter name (LAND=land/sea mask)
5. Indicator of parameter and units (GRIB PDS octet 9)
6. Type of level/layer (GRIB PDS octet 10)
7. Height, pressure, etc (GRIB PDS octets 11-12)
8. Time Range (GRIB PDS octet 21)
9. Period of time 1, (GRIB PDS octet 19)
10. Period of time 2, (GRIB PDS octet 20)
11. Forecast time unit (GRIB PDS octet 18)
12. level
13. anl=analysis, fcst=forecast
14. NAve (number of grids used to make average)

*** Short Inventory ***

The short inventory can be obtained using the -s option. This inventory is easier to read the the previous inventory and can also be used as an index file.

```
%WGRIB -s land.grb -ncep_rean
1:0:d=87010100:LAND:sfc:anl:NAve=1
```

1. Record number
2. Position in bytes
3. Date (YYMMDDHH).
4. Parameter name (LAND=land/sea mask)
6. Type of level/layer (GRIB PDS octet 10)
7. Forecasts, analysis, etc
8. For an average, the number of fields averaged together

***** Verbose Inventory *****

The small verbose inventory can be obtained using the -v option. This inventory can be used as an index file.

```
% WGRIB -v land.grb -ncep_rean
1:0:D=1987010100:LAND:kpds=81,1,0:sfc:anl:"Land-sea mask [1=land; 0=sea]
```

1. Record number
2. Position in bytes
3. Date (YYYYMMDDHH).
4. Parameter name (LAND=land/sea mask)
5. KPDS5, KPDS6, KDPS7 (PDS Octets 9, 10, 11-12)
6. Type of level/layer (GRIB PDS octet 10)
7. Forecasts, analysis, etc
8. Description of parameter type

***** Verbose Description *****

The fourth type of file description can not be used as an index file. However, it is more human readable. It gives you information that is not normally available such as grid dimensions. Using the test file land.grb, you should be able to enter:

```
%WGRIB land.grb -V -ncep_rean

rec 1:0:date 1987010100 LAND kpds5=81 kpds6=1 kpds7=0 levels=(0,0) grid=255
sfc anl:

LAND=Land-sea mask [1=land; 0=sea]
timerange 0 P1 0 P2 0 TimeU 1  nx 192 ny 94 GDS grid 4 num_in_ave 1 missing 0
center 7 subcenter 0 process 80 Table 2
gaussian: lat  88.542000 to -88.542000
          long 0.000000 to -1.875000 by 1.875000,
          (192 x 94) scan 0 bdsgrid 1
          min/max data 0 1  num bits 4  BDS_Ref 0  DecScale 1 BinScale 0
```

The first line states
- the record 1 starts at byte position 0
- the initial date is January 1, 1987 at 00Z
- the parameter is "LAND" (numeric code 81, PDS octet 9)
- with a level type 1 (kdps6=1, PDS octet 10)
- and value 0 (PDS octets 11-12)
- or levels(0,0) (PDS octet 11, PDS octet 12)
- with a user defined grid (grid=255)
- and it is a surface analysis

The second line is a further description of the parameter type

The third line describes
- timerange (PDS octet 21)
- P1 (PDS octet 19)
- P2 (PDS octet 20)
- TimeU (PDS octet 14)
- nx ny grid size as used by WGRIB
- GDS grid (GDS octet 6)
- num_in_ave (PDS octet 22-23)
- number missing from average (PDS octet 24)

```
The fourth line describes
        center (PDS octet 5)
        subcenter (PDS octet 26)
        process (PDS octet 6)
        parameter table version (PDS octet 4)

The fifth and sixth lines describe the grid type

The last line describes
        minimum and maximum values of the data
        the number of bits used to store the data
        the minimum value
        the decimal and binary scaling used
```

Most of the information within this description will only make sense if you have a copy of the GRIB definition as reference.

If you want to determine the contents of record N, try the command:

```
    %WGRIB land.GRIB -V -d N
```

This command also writes a binary dump of the record but it's quick. If you don't want a binary dump, try (on a UNIX machine),

```
    %WGRIB land.GRIB -V -d N -o /dev/null
```

***** Extracting Data *****

The second major function of WGRIB is to extract data from a GRIB file. The output can be binary, IEEE (big endian), GRIB and text. All output formats except GRIB can be written with or without a header. See FORMATS.TXT for more information. The '-append' option appends the extracted data and the '-o [filename]' allows you to set the default output file which is normally "dump".

```
    Note: binary format with a header is often compatible with FORTRAN code.
    Note: IEEE output is "big-endian".
    Note: writing in binary is faster than writing ieee.
    Note: using a binary format is faster, more precise and uses less disk
          space than the text format.
```

Note: The standard NCEP convention is that the arrays are stored in FORTRAN order starting from the north and 0E. The following data goes south and eastward.

***** How to select data to be extracted *****

```
1) by record number
     WGRIB land.GRIB -d 1     (extract first record)

2) by position
     WGRIB land.GRIB -p 0     (extract record starting at byte 0)

3) by (machine readable) inventory (UNIX/AMIGA/MS-DOS)
     WGRIB land.grb | WGRIB -i land.grb -o output.bin
```

The third method is the most powerful one. Suppose you have a GRIB file with many different fields. You want to extract all the zonal winds (UGRD in NCEP files), you could type at a Unix machine:

```
WGRIB GRIB_file | grep ":UGRD:" | WGRIB GRIB_file -i
```

Suppose you want to extract the 500 mb U winds, then you could type at a Unix machine:

```
WGRIB GRIB_file -s | grep ":UGRD:" | grep ":500 mb:" | WGRIB -i GRIB_file
```

For more information on how to write ieee, binary, text and GRIB files see the file FORMATS.TXT.

***** Some Output Formats *****

Binary with a f77-style header

Suppose you wish to convert all the 500 mb heights (HGT in NCEP files) to binary with a header. The following line would convert "infile" to "outfile".

```
  % WGRIB -s infile | grep ":HGT:500 mb:" | WGRIB -i infile -o outfile
```

The "outfile" is often compatible with the FORTRAN compiler.

Binary with no header

Suppose you wish to convert all the 500 mb heights (HGT) to binary with a NO header. The following line would convert "infile" to "outfile".

```
  % WGRIB -s infile | grep ":HGT:500 mb:" | WGRIB -i -nh infile -o outfile
```

The "outfile" is often compatible with FORTRAN direct-access I/O.

Text

Converting a GRIB file into a text file is slow (reading and writing), takes up much more disk space and can have less precision. Nevertheless it has its uses.

```
  % WGRIB -s infile | grep ":HGT:500 mb:" | WGRIB -i -text infile -o outfile
```

IEEE

Most workstations computers use big-endian IEEE as their binary format. For these machines, one should not use the -ieee option as it is slower and could lose some precision. However, the following line will create a big-endian IEEE with f77-style headers.

```
  % WGRIB -s infile | grep ":HGT:500 mb:" | WGRIB -i -ieee infile -o outfile
```

Without headers, one would use

```
% WGRIB -s infile | grep ":HGT:500 mb:" | WGRIB -i -nh -ieee infile -o outfile
```

GRIB

Suppose you have a large file with every variable imaginable. But you are a simple person with limited means. You only want the 500 mb heights and you have limited disk space. The following will extract the 500 mb heights as a GRIB file.

```
% WGRIB -s infile | grep ":HGT:500 mb:" | WGRIB -i -GRIB infile -o outfile
```

5. **Access Method and Sort for Supplied Data:**

Please see paragraph 4 above and refer to Appendix W for the WGRIB source code listing.

6. **Element Names and Definitions:**

Pressure Level Data - The fields include: horizontal winds, omega (dP/dt), geopotential height, specific/relative humidity, absolute vorticity and divergence, The data are on standard pressure levels every 6 hours.

Isentropic Level Data - Data on isentropic surfaces include: horizontal winds, mass-weighted horizontal winds, omega (dP/dt), temperature, potential vorticity, relative humidity, Montgomery stream function, Brunt-Vaisala freq. squared, and potential temperature at the surface. This data is available on 10 isentropic surfaces every 6 hours.

Sigma Level Data: Gridded - Gridded data on sigma surfaces include: rel. vorticity, divergence, temperature, specific humidity, horizontal winds, surface pressure, geopotential height.

Sigma Level Data: Spectral - The atmospheric analysis is available as a spectral sigma file. This is the only file with full precision data. For most problems, the truncation used by the GRIB files are reasonable. (For example, the temperatures are stored to the nearest 1/10 of a degree which is better than your average thermometer reading.) However, those needing higher vertical resolution should go to the original spectral sigma files.

Diabatic Heating - One huge database is the diabatic heating and sub-grid momentum fluxes on the 28 sigma levels every 6 hours. One reason this set of data is so huge is that the diabatic heating is divided into its various components such as long wave heating.

Radiation Related Quantities - Quantities include: LW/SW cloud forcing, clear/cloudy, LW/SW, upward/downward fluxes.

Clouds & Precipitation - Fields include: total cloud cover, convective and total precipitation.

Misc. Fields - The other fields include: surface wind stress, latent/sensible heat flux, soil temperature/moisture, gravity wave drag, SST, 2m temperature, 2m humidity, 10m winds, runoff, mean sea level pressure, surface pressure, and snow.

Not quite Analyses - Other Reanalysis products include the first guess, hindcast forecasts (the skill of the forecasts give some idea about the quality of the analyses), BUFR data (the raw data from aircraft, rawinsondes, satellite, etc), optimal averages, statistics of the raw data utilization, and even a GCM simulation (sea-ice, SST boundary conditions).

NCEP/NCAR Reanalysis Comprehensive Output Variables

The output variables are classified into four categories, depending on the relative influence of the observational data and the model on the gridded variable. An A indicates that the analysis variable is strongly influenced by observed data, and hence it is in the most reliable class (e.g., upper air temperature and wind). The designation B indicates that, although there are observational data that directly affects the value of the variable, the model also has a very strong influence on the analysis value (e.g., humidity, and surface temperature). The letter C indicates that there are no observations directly affecting the variable, so that it is derived solely from the model fields forced by the data assimilation to remain close to atmospheric equalibrium under current observations (e.g., clouds and precipitation). Finally, the letter D represents a field that is fixed from climatological values, and does not depend on the model (e.g., vegetation index, plant resistance, land-sea mask). Although the classification of variables is necessarily somewhat subjective, the user should exercise caution in interpreting the results of the reanalysis, especially for variables classified in categories B and C. In addition to this rule of thumb, the user should keep in mind that quadratic variables (e.g., kinetic energy, transport of water vapor) are in general less reliable than the components from which they were computed.

Standard GRIB output

Pressure: Pressure coordinate output

... Regular latitude-longitude grid (2.5o x 2.5o)
... All fields are instantaneous values at a given time

A Geopotential height (gpm) at 17 levels
A u-wind (m/s) 17 levels
A v-wind (m/s) 17 levels
A Temperature (K) 17 levels
B Pressure vertical velocity (Pa/s) 12 levels
B Relative humidity (%) 8 levels
A Absolute vorticity (/s) 17 levels
A u-wind of the lowest 30 hPa layer (m/s)
A v-wind of the lowest 30 hPa layer (m/s)
B Temperature of the lowest 30 hPa layer (K)
B Relative humidity of the lowest 30 hPa (%)
B Pressure at the surface (Pa)
B Precipitable water (kg/m2)
B Relative humidity of the total atmospheric column (%)
A Temperature at the tropopause (K)
A Pressure at the tropopause (Pa)
A u-wind at the tropopause (m/s)
A v-wind at the tropopause (m/s)
A Vertical speed shear at the tropopause (1/s)

B Surface lifted index (K)
B "Best" (4-layer) lifted index (K)
A Temperature at the maximum wind level (K)
A Pressure at the maximum wind level (Pa)
A u-wind at the maximum wind level (m/s)
A v-wind at the maximum wind level (m/s)
D Geopotential height at the surface (gpm)
A Pressure reduced to MSL (Pa)
B Relative humidity in 3 sigma layers:

0.44-0.72(%)
0.72-0.94(%)
0.44-1.0(%)

B Potential temperature at the lowest sigma level (K)
B Temperature at the lowest sigma level (K)
B Pressure vertical velocity at the lowest sigma level (Pa/s)
B Relative humidity at the lowest sigma level (%)
B u-wind at the lowest sigma level (m/s)
B v-wind at the lowest sigma level (m/s)

Grb2d...2-dimensional diagnostic file

C Cloud forcing net longwave flux at the top of atmosphere (W/m2)
C Cloud forcing net longwave flux at the surface (W/m2)
C Cloud forcing net longwave flux for total atmospheric column(W/m2)
C Cloud forcing net solar flux at the top of the atmosphere (W/m2)
C Cloud forcing net solar flux at the surface (W/m2)
C Cloud forcing net solar flux for total atmospheric column (W/m2)
C Convective precipitation rate (kg/m2/s)
C Clear sky downward longwave flux at the surface (W/m2)
C Clear sky downward solar flux at the surface (W/m2)
C Clear sky upward longwave flux at the top of the atmosphere(W/m2)
C Clear sky upward solar flux at the top of atmosphere (W/m2)
C Clear sky upward solar flux at the surface (W/m2)
C Cloud work function (J/Kg)
C Downward longwave radiation flux at the surface (W/m2)
C Downward solar radiation flux at the top of the atmosphere (W/m2)
C Downward solar radiation flux at the surface (W/m2)
C Ground heat flux (W/m2)
D Ice concentration (ice=1;no ice=0) (1/0)
D Land-sea mask (1=land;0=sea) (integer)
C Latent heat flux (W/m2)
C Near IR beam downward solar flux at the surface (W/m2)
C Near IR diffuse downward solar flux at the surface (W/m2)
C Potential evaporation rate (w/m2)
C Precipitation rate (kg/m2/s)
C Pressure at high cloud top (Pa)
C Pressure at high cloud base (Pa)
C Pressure at middle cloud top (Pa)
C Pressure at middle cloud base (Pa)
C Pressure at low cloud top (Pa)
C Pressure at low cloud base (Pa)
C Pressure at the surface (Pa)
C Run off (kg/m2 per 6 hour interval)
D Surface roughness (m)

C Nearby model level of high cloud top (integer)
C Nearby model level of high cloud base (integer)
C Nearby model level of middle cloud top (integer)
C Nearby model level of middle cloud base (integer)
C Nearby model level of low cloud top (integer)
C Nearby model level of low cloud base (integer)
C Sensible heat flux (W/m**2)
C Volumetric soil moisture content (fraction) (2 layers)
B Specific humidity at 2m (kg/kg)
C Total cloud cover of high cloud layer (%)
C Total cloud cover of middle cloud layer (%)
C Total cloud cover of low cloud layer (%)
B Maximum temperature at 2m (K)
B Minimum temperature at 2m (K)
AB Temperature at the surface (skin temperature) (K)
C Temperature of the soil layer (3 layers) (K)
B Temperature at 2m (K)
C Temperature of high cloud top (K)
C Temperature of low cloud top (K)
C Temperature of middle cloud top (K)
C Zonal gravity wave stress (N/m2)
B Zonal component of momentum flux (N/m2)
B u-wind at 10m (m/s)
C Upward longwave radiation flux at the top of the atmosphere(W/m2)
C Upward longwave radiation flux at the surface (W/m2)
C Upward solar radiation flux at the top of the atmosphere (W/m2)
C Upward solar radiation flux at the surface (W/m2)
C Meridional gravity wave stress (N/m2)
C Visible beam downward solar flux at the surface (W/m2)
C Visible diffuse downward solar flux at the surface (W/m2)
C Meridional component of momentum flux (N/m2)
B v-wind at 10m (m/s)
C Water equivalent of accum. snow depth (kg/m2)

Grb3d...3-dimensional diagnostic file

... Gaussian grid (192 x 94) on 28 model levels
... All fields are average of 6 hour integration starting from a given time

C Deep convective heating rate (K/s)
C Deep convective moistening rate (kg/kg/s)
C Large scale condensation heating rate (K/s)
C Longwave radiative heating rate (K/s)
C Shallow convective heating rate (K/s)
C Shallow convective moistening rate (kg/kg/s)
C Solar radiative heating rate (K/s)
C Vertical diffusion heating rate (K/s)
C Vertical diffusion moistening rate (kg/kg/s)
C Vertical diffusion zonal accel. (m/s/s)
C Vertical diffusion meridional accel. (m/s/s)

Sigma

... Gaussian grid (192 x 94) on 28 model levels or surface
... All fields are instantaneous values at a specified time

```
A Relative vorticity (28 levels) (/s)
B Divergence (28 levels) (/s)
A Temperature (28 levels) (K)
B Specific humidity (28 levels) (kg/kg)
A x-gradient of log pressure (surface) (1/m)
A y-gradient of log pressure (surface) (1/m)
A u-wind (28 levels) (m/s)
A v-wind (28 levels) (m/s)
A Pressure (surface) (Pa)
A Geopotential height (surface) (gpm)
A x-gradient of height (surface) (m/m)
A y-gradient of height (surface) (m/m)

Isen..Isentropic coordinate output

... Gaussian grid (192 x 94) most on 10 isentropic levels
... All fields are instantaneous values at a specified time

A Potential temperature (surface) (K)
A Temperature (K)
A u-wind (m/s)
A v-wind (m/s)
B Pressure vertical velocity (Pa/s)
B Relative humidity (%)
A Montgomery stream function (m2/s2)
B Brunt-Vaisala frequency squared (1/s2)
B Potential vorticity (m2/s/kg)

Other non-GRIB output files

Zonal diagnostic file (binary)

... Average over 90S-60S, 60S-30S, 30S-30N, 30N-60N, 60N-90N and global
... Unmarked fields are instantaneous values at a given time
... (Av) indicates average during the 6 hour integration

A u component of wind (m/s)                    at 28 model levels
A v component of wind (m/s)                    at 28 model levels
A virtual temperature (K)                      at 28 model levels
B specific humidity (g/g)                      at 28 model levels
B squared vorticity (1/s2)                     at 28 model levels
C squared divergence (1/s2)                    at 28 model levels
B pressure vertical velocity (Pa/s)            at 28 model levels
A temperature (K)                              at 28 model levels
B relative humidity (%)                        at 28 model levels
B kinetic energy (m2/s2)                       at 28 model levels
C convective heating (K/s)                     at 28 model levels (Av)
C large scale heating (K/s)                    at 28 model levels (Av)
C shallow convection heating (K/s)             at 28 model levels (Av)
C vertical diffusion heating (K/s)             at 28 model levels (Av)
C convective moistening (g/g/s)                at 28 model levels (Av)
C shallow convection moistening (g/g/s)        at 28 model levels (Av)
C vertical diffusion moistening (g/g/s)        at 28 model levels (Av)
C zonal accel by vertical diffusion (m/s2)     at 28 model levels (Av)
C meridional accel by vertical diffusion (m/s2) at 28 model levels
C short wave radiation heating (K/s)           at 28 model levels (Av)
```

C long wave radiation heating (K/s) at 28 model levels (Av)
C total precipitation (Kg/m2) (Av)
C convective precipitation (Kg/m2) (Av)
C sensible heat flux (w/m2) (Av)
C latent heat flux (w/m2) (Av)
B zonal stress (dyn/m2) (Av)
B meridional stress (dyn/m2) (Av)
C rain area coverage (%)
C convective rain area coverage (%)
B surface pressure (hPa)
C surface skin temperature (K)
C soil wetness (cm)
C snow depth (m)
C 10 cm deep soil temperature (K)
C 50 cm deep soil temperature (K)
D 500 cm deep soil temperature (K)
C surface net short wave flux (W/m2) (Av)
C surface net long wave flux (W/m2) (Av)
B relative humidity at the lowest model level (%)
B virtual temp at the lowest model level (K)
B temperature at the lowest model level (K)
B specific humidity at the lowest model level (K)
D surface roughness (m)
D land sea sea-ice mask (int)
C zonal accel by gravity wave drag (m/s2) (Av)
C meridional accel by gravity wave (m/s2) (Av)
B surface torque (g/m2/s2) (Av)
C gravity wave drag torque (g/m2/s2) (Av)
B mountain torque (g/m2/s2) (Av)
B total angular momentum (m2/s)
B planetary angular momentum (m2/s)

Output levels

Standard Pressure levels (hPa):

1000,925,850,700,600,500,400,300,250,100,150,100,70,50,30,20,10

Isentropic surfaces (degrees K):

650,550,450,400,350,330,315,300,290,280,270

Sigma levels:

0.9950	0.9821	0.9644	0.9425	0.9159	0.8838	0.8458	0.8014
0.7508	0.6943	0.6329	0.5681	0.5017	0.4357	0.3720	0.3125
0.2582	0.2101	0.1682	0.1326	0.1028	0.0782	0.0580	0.0418
0.0288	0.0183	0.0101	0.0027				

7. **Start Date:**

January 1, 1958

8. **Stop Date:**

Data through December 31, 1997 has been processed.

Data for 1998 will be made available by month as soon as it is processed.

9. **Coverage:**

a. Southernmost Latitude: 90S
b. Northernmost Latitude: 90N
c. Westernmost Longitude: 180W
d. Easternmost Longitude: 180E

10. **Location:**

a. global

11. **Keywords:**

beam
clear
cloud
concentration
convective
depth
diffuse
divergence
downward
evaporation
flux
geopotential
gravity
ground
heat
height
humidity
ice
index
IR
land
land-sea
latent
lifted
longwave
mask
maximum
meridional
minimum
moisture
momentum
natural log of pressure
near
net
omega
orography
potential
precipitation
pressure
radiation
relative

roughness
runoff
sea
sensible
sky
snow
soil
solar
stress
temperature
upward
velocity
vertical
virtual
visible
volumetric
vorticity
water
wave
wind
zonal

12. **How to Order Data:**

National Climatic Data Center
Federal Building
151 Patton Avenue
Asheville, NC 28801-5001
phone: (828) 271-4800
email: orders@ncdc.noaa.gov

13. **Archiving Data Center:**

National Climatic Data Center
Federal Building
151 Patton Avenue
Asheville, NC 28801-5001
phone: (828) 271-4800
email: questions@ncdc.noaa.gov

14. **Technical Contact:**

National Climatic Data Center
Federal Building
151 Patton Avenue
Asheville, NC 28801-5001
phone: (828) 271-4800
email: questions@ncdc.noaa.gov

15. **Known Uncorrected Problems:**

For data problems that have occurred please refer to:

http://www.cdc.noaa.gov/cdc/reanalysis/problems.shtml

16. **Quality Statement:**

NCDC performs no additional quality assessment of the data supplied.

17. **Revision Date:**

6 July, 1998

18. **Source Data Sets:**

NCEP and NCAR are cooperating in a project (denoted "Reanalysis") to produce a 40-year record of global analyses of atmospheric fields in support of the needs of the research and climate monitoring communities. This effort involves the recovery of land surface, ship, rawinsonde, pibal, aircraft, satellite and other data, quality controlling and assimilating these data with a data assimilation system which is kept unchanged over the reanalysis period 1957 through 1996. This eliminates perceived climate jumps associated with changes in the data assimilation system.

19. **Essential Companion Data Sets:**

none

20. **Derived Data Sets:**

Overview of data sets available at the National Climatic Data Center:

TD#	Dataset Name
6160	6 HR FORECAST OF PARAMETERS ON THE MODEL BASED SIGMA LEVELS
6161	PARAMETERS ON THE MODEL BASED SIGMA LEVELS
6162	SURFACE AND RADIATION PARAMETERS
6163	ANALYZED PARAMETERS ON 11 POTENTIAL (ISENTROPHIC) PRESSURE LEVELS
6164	ANALYZED PARAMETERS AT 17 STANDARD PRESSURE LEVELS
6165	6HR FORECAST OF THE ANALYZED PARAMETERS AT 17 STANDARD PRESSURE LEVELS
6166	TIME SERIES SYNOPTIC ON P-MAND
6167	TIME SERIES SYNOPTIC IPVANL
6168	TIME SERIES MONTHLY MEAN
6169	MONTLY MEAN 3D HEATING MOISTURING AND EXCELERATION ON SIGMA
6170	INPUT DATA FOR THE MODEL (i.e. RADIOSONDE AND SURFACE OBSERVATIONS, AIRCRAFT, SHIP AND SATELLITE MEASUREMENTS)

21. **References:**

"The NCEP/NCAR 40-Year Reanalysis Project", Bulletin of the American Meteorological Society, March 1996
http://www.scd.ucar.edu/dss/pub/reanalysis/index.html
http://wesley.wwb.noaa.gov/reanlysis.html
http://wesley.wwb.noaa.gov/types_data.html
http://www.cdc.noaa.gov/cdc/reanalysis/problems.shtml

22. **Summary:**

Until recently, the meteorological community has had to use analyses that supported the real-time weather forecasting. These analyses are very inhomogeneous in time as there have been big improvements in the data assimilation systems. This played havoc with climate monitoring as these improvements were often produced changes in the apparent "climate". Even fundamental quantities such as the strength of the Hadley cell has changed over the years as a result of the changes in the data assimilation systems.

The NCEP/NCAR 40-year reanalysis uses a frozen state-of-the-art global data assimilation system, and a data base as complete as possible. The data assimilation and the model used are identical to the global system implemented operationally at NCEP on 11 January 1995, except that the horizontal resolution is T62 (about 210 km). The data base has been enhanced with many sources of observations not available in real time for operations, provided by different countries and organizations. The system has been designed with advanced quality control and monitoring components, and can produce one month of reanalysis per day on a CRAY YMP/8 supercomputer.

The quality and utility of the re-analyses should be superior to NCEP's original analyses because

- a state-of-the-art data assimilation is used
- more observations are used
- quality control has been improved
- the model/data assimilation procedure will remain essentially unchanged during the project
- many more fields are being saved (ex. potential vorticity on isentropic surfaces, diabatic heating)
- global (some older analyses were hemispheric)
- better vertical resolution (stratosphere)

Appendix A

TD 6160

Surface Flux Data

Archive parameters: File names are composed of variable abbreviations, level, and year:

(variable).(level).gauss.(year).nc

Variables on or near the surface:	File	Units	Least Sig. Digit
These variables (air.sfc - weasd) are 6 hour forecasts.			
Air Temperature	air.sfc	degK	0.1
Air Temperature at 2 meters	air.2m	degK	0.1
Ice concentration	icec.sfc	(0 or 1)	1.
Potential evaporation rate	pevpr.sfc	W/m^2	1.
Pressure	pres.sfc	Pascals	0.
Water runoff	runof.sfc	Kg/m^2	0.1
Surface roughness	sfcr.sfc	m	0.00001
Specific humidity at 2 meters	shum.2m	kg/kg	0.0001
Volumetric soil moisture (0-10cm)	soilw.0-10cm	fraction	0.001
Volumetric soil moisture (10-200cm)	soilw.10-200cm	fraction	0.001
Maximum temperature at 2m layer	tmax.2m	degK	0.1
Minimum temperature at 2m layer	tmin.2m	degK	0.1
Temperature of 0-10cm layer	tmp.0-10cm	degK	0.1
Temperature of 10-200cm layer	tmp.10-200cm	degK	0.1
Temperature at 300cm	tmp.300cm	degK	0.1
U-wind at 10 m	uwnd.10m	m/s	0.1
V-wind at 10 m	vwnd.10m	m/s	0.1
Water equiv. of accum. snow depth	weasd.sfc	kg/m^2	1.
These variables (cfnlf.sfc - vgwd) are 6 hour averages starting at the reference time.			
Cloud forcing net longwave flux	cfnlf.sfc	W/m^2	1.
Cloud forcing net solar flux	cfnsf.sfc	W/m^2	1.
Convective precipitation rate	cprat.sfc	Kg/m^2/s	0.000001
Clear sky downward longwave flux	csdlf.sfc	W/m^2	1.
Clear sky downward solar flux	csdsf.sfc	W/m^2	1.
Downward longwave radiation flux	dlwrf.sfc	W/m^2	1.
Downward solar radiation flux	dswrf.sfc	W/m^2	1.
Ground heat flux	gflux.sfc	W/m^2	1.
Latent heat net flux	lhtfl.sfc	W/m^2	1.
Near IR beam downward solar flux	nbdsf.sfc	W/m^2	1.
Near IR diffuse downward solar flux	nddsf.sfc	W/m^2	1.
Net longwave radiation	nlwrs.sfc	W/m^2	1.
Net shortwave radiation	nswrs.sfc	W/m^2	1.
Precipitation rate	prate.sfc	Kg/m^2/s	0.000001
Sensible heat net flux	shtfl.sfc	W/m^2	1.
Zonal component of momentum flux	uflx.sfc	N/m^2	0.001
Zonal gravity wave stress	ugwd.sfc	N/m^2	0.001
Upward longwave radiation flux	ulwrf.sfc	W/m^2	1.

Upward solar radiation flux	uswrf.sfc	W/m^2	1.
Visible beam downward solar flux	vbdsf.sfc	W/m^2	1.
Visible diffuse downward solar flux	vddsf.sfc	W/m^2	1.
Meridional component of momentum flux	vflx.sfc	N/m^2	0.001
Meridional gravity wave stress	vgwd.sfc	N/m^2	0.001
Land-sea mask (time invariant) *	land.sfc	(0 or 1)	1.

* = no year in file name

Note:

The air.sfc files contain skin temperature as described in the March, 1996 BAMS article. As such, over land and sea ice, the temperature is a prognostic variable. Over open water, the skin temperature is fixed at its initial value; i.e., the Reynolds SST as seen by the model. The Reynolds' SST analyses were done weekly and the reconstructed SST done monthly. The analyses were linearly interpolated to daily values which were used for all four analyses.

The following variables are 6 hour forecasts values valid at the reference time:

air.sfc, air.2m, icec.sfc, pres.sfc, runof.sfc, sfcr.sfc, shum.2m, soilw.0-10cm, soilw.10-200cm, tmax.2m, tmin.2m, tmp.0-10cm, tmp.10-200cm, tmp.300cm, uwnd.10m, vwnd.10m, weasd.sfc, land.sfc

The following variables are six hour averages for the period of the reference time plus six hours:

cfnlf.sfc, cfnsf.sfc, cprat.sfc, csdlf.sfc, csdsf.sfc, dlwrf.sfc, dswrf.sfc, gflux.sfc, lhtfl.sfc, nbdsf.sfc, nddsf.sfc, prate.sfc, shtfl.sfc, uflx.sfc, ugwd.sfc, ulwrf.sfc, uswrf.sfc, vbdsf.sfc, vddsf.sfc, vflx.sfc, vgwd.sfc, nlwrs.sfc, nswrs.sfc

Spatial coverage:

* T62 Gaussian grid with 192x94 points
* 88.542N-88.542S, 0E-358.125E

Temporal coverage:

* 1/1/1958 - 12/31/1997 with output every 6 hours
* Data for the current year (1998) from the CDAS program is being made available along with the historical data. Files for 1998 contain as many months as are currently available. All variables are available except net longwave radiation and net shortwave radiation.

Levels:

* Surface or near the surface

Missing data:

* None

Data set format and size:

* All data are stored in netCDF files
* The data are divided by variable and year into separate files
* There are 1,679 files currently
* Files are 52 Mbytes per variable per year
* Current total of 88.5 Gbytes for 4xDaily and 6.3 Gbytes for daily averages

Availability and usage restrictions:

* Daily averages are available by anonymous FTP from ftp.cdc.noaa.gov in . /Datasets/ncep.reanalysis.dailyavgs/surface_gauss.
* The daily average data files are also available by request on 8mm tapes. To order tapes use the on-line order form.
* The 4x daily data files are only available outside of CDC by request on 8mm tapes due to large file sizes. To order tapes use the on-line order form.
* No usage restrictions.

Appendix B

TD 6161

T62 Spectral Coefficients

Archive parameters: File names are composed of variable abbreviations and year:

(variable).spec.(year).nc

Variables as spectral coeffs.:	File	Units	Least Sig. Digit
Divergence	div	1./s	0.1
Orography	orog	m	n/a
Natural Log of Pressure	pres	nlog(centibars)	1.0
Specific Humidity	shum	kg/kg	0.0001
Virtual Air Temperature	vair	degK	1.0
Vorticity	vort	1./s	0.1

Note:

These variables are instantaneous values at the reference time.

Spatial coverage:

* T62 Spectral Coefficients

Temporal coverage:

* 1/1/1958 - 12/31/1997 with output every 6 hours

Levels:

* 28 Sigma levels: 0.995, 0.9821, 0.9644, 0.9425, 0.9159, 0.8838, 0.8458, 0.8014, 0.7508, 0.6943, 0.6329, 0.5681, 0.5017, 0.4357, 0.372, 0.3125, 0.2582, 0.2101, 0.1682, 0.1326, 0.1028, 0.0782, 0.058, 0.0418, 0.0288, 0.0183, 0.0101, 0.0027

* Some variables not defined at all levels.

Missing data:

* None

Data set format and size:

* All data are stored in netCDF files
* The data are divided by variable and year into separate files
* There are 196 files currently
* Sizes range from 17 Kbytes to 331 Mbytes per variable per year
* Current total of 52 Gbytes for 4xDaily

Availability and usage restrictions:

* There are no daily averages for the spectral data available from CDC.

* The 4x daily data files available by anonymous FTP from ftp.cdc.noaa.gov in /Datasets/nmc.reanalysis/spectral.
* The 4x daily data are also available on 8mm tape. To order tapes use the on-line order form.
* No usage restrictions.

Appendix C

TD 6162

Surface Data

Archive parameters: File names are composed of variable abbreviations, level, and year:

(variable).(level).(year).nc

Variables on or near the surface:	File	Units	Least Sig. Digit
Air Temperature	air.sig995	degK	0.1
Surface lifted index	lftx.sfc	degK	0.1
Best (4-layer) lifted index	lftx4.sfc	degK	0.1
Omega (vertical velocity)	omega.sig995	Pascal/s	0.001
Potential temperature	pottmp.sig995	degK	0.1
Precipitable water	pr_wtr.eatm	kg/m^2	0.1
Pressure	pres.sfc	Pascals	10.0
Relative humidity	rhum.sig995	%	1.0
Sea level pressure	slp	Pascals	10.0
U-wind	uwnd.sig995	m/s	0.1
V-wind	vwnd.sig995	m/s	0.1
Geopotential hgt (time invariant) *	hgt.sfc	m	1.0
Land-sea mask (time invariant) **	land		1.0

* = no year in file name
** = no year or level in filename

Note:

These variables are instantaneous values at the reference time.

Spatial coverage:

* 2.5-degree latitude x 2.5-degree longitude global grid with 144x73 points
* 90N-90S, 0E-357.5E

Temporal coverage:

* 1/1/1958 - 12/31/1997 with output every 6 hours
* Data for the current year (1998) from the CDAS program is being made available along with the historical data. Files for 1998 contain as many months as are currently available. All variables are available except precipitable water.

Levels:

* Surface or near the surface (.995 sigma level)
* Also, precipitable water is included here, because it is a 3-D file on a 2.5 degree grid, but it is not a surface value, but rather for the entire atmospheric column

Missing data:

* None

Data set format and size:

* All data are stored in netCDF files
* The data are divided by variable and year into separate files
* There are 441 files currently
* Files are 30 Mbytes per variable per year
* Current total of 13.4 Gbytes for 4xDaily and 3.4 Gbytes for daily averages

Availability and usage restrictions:

* Daily averages are available by anonymous FTP from ftp.cdc.noaa.gov in /Datasets/ncep.reanalysis.dailyavgs/surface.
* The daily average data files are also available by request on 8mm tapes. To order tapes use the on-line order form.
* The 4x daily data files are only available outside of CDC by request on 8mm tapes due to large file sizes. To order tapes use the on-line order form.
* No usage restrictions.

Appendix E

TD 6164

Pressure Level Data

Archive parameters: File names are composed of variable abbreviations and year: (variable).(year).nc

Variables on pressure levels:	File	Units	Least Sig. Digit
Air temperature	air	degK	0.1
Geopotential height	hgt	m	1.
Relative humidity	rhum	%	1.
Specific humidity	shum	kg/kg	0.00001
Omega (vertical velocity)	omega	Pascal/s	0.001
U-wind	uwnd	m/s	0.1
V-wind	vwnd	m/s	0.1

Note: These variables are instantaneous values at the reference time.

Spatial coverage:

* 2.5-degree latitude x 2.5-degree longitude global grid with 144x73 points.
* 90N-90S, 0E-357.5E

Temporal coverage:

* 1/1/1958 - 12/31/1997 with output every 6 hours
* Data for the current year (1998) from the CDAS program is being made available along with the historical data. Files for 1998 contain as many months as are currently available.

Levels:

* 17 pressure levels (hPa): 1000, 925, 850, 700, 600, 500, 400, 300,
  250, 200, 150, 100, 70, 50, 30, 20, 10
* some variables not defined at all levels

Missing data:

* None

Data set format and size:

* All data are stored in netCDF files
* The data are divided by variable and year into separate files
* There are 279 files currently
* Sizes range from 245 Mbytes to 521 Mbytes per variable per year
* Current total of 118 Gbytes for 4xDaily and 29.4 Gbytes for daily averages

Availability and usage restrictions:

* Daily averages are available by anonymous FTP from ftp.cdc.noaa.gov in /Datasets/ncep.reanalysis.dailyavgs/pressure.

* The daily average data files are also available by request on 8mm tapes. To order tapes use the on-line order form.
* The 4x daily data files are only available outside of CDC by request on 8mm tapes due to large file sizes. To order tapes use the on-line order form.
* No usage restrictions.

Appendix F

TD 6165

Pressure Level Data - 6 hour forecast

Archive parameters: File names are composed of variable abbreviations and year: (variable).(year).nc

Variables on pressure levels:	File	Units	Least Sig. Digit
Air temperature	air	degK	0.1
Geopotential height	hgt	m	1.
Relative humidity	rhum	%	1.
Specific humidity	shum	kg/kg	0.00001
Omega (vertical velocity)	omega	Pascal/s	0.001
U-wind	uwnd	m/s	0.1
V-wind	vwnd	m/s	0.1

Note: These variables are instantaneous values at the reference time.

Spatial coverage:

* 2.5-degree latitude x 2.5-degree longitude global grid with 144x73 points.
* 90N-90S, 0E-357.5E

Temporal coverage:

* 1/1/1958 - 12/31/1997 with output every 6 hours
* Data for the current year (1998) from the CDAS program is being made available along with the historical data. Files for 1998 contain as many months as are currently available.

Levels:

* 17 pressure levels (hPa): 1000, 925, 850, 700, 600, 500, 400, 300,
  250, 200, 150, 100, 70, 50, 30, 20, 10
* some variables not defined at all levels

Missing data:

* None

Data set format and size:

* All data are stored in netCDF files
* The data are divided by variable and year into separate files
* There are 279 files currently
* Sizes range from 245 Mbytes to 521 Mbytes per variable per year
* Current total of 118 Gbytes for 4xDaily and 29.4 Gbytes for daily averages

Availability and usage restrictions:

* Daily averages are available by anonymous FTP from ftp.cdc.noaa.gov in /Datasets/ncep.reanalysis.dailyavgs/pressure.

* The daily average data files are also available by request on 8mm tapes. To order tapes use the on-line order form.
* The 4x daily data files are only available outside of CDC by request on 8mm tapes due to large file sizes. To order tapes use the on-line order form.
* No usage restrictions.

Appendix W

Sample WGRIB Source Code

The following C code is a partial listing of WGRIB. The full listing can be downloaded from the location:

ftp://wesley.wwb.noaa.gov/pub/WGRIB/WGRIB.c

WGRIB

```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <stddef.h>
#include <math.h>
#include <float.h>
/* version 1.2.1 of GRIB headers  w. ebisuzaki */

#ifndef INT2
#define INT2(a,b)   ((1-(int) ((unsigned) (a & 0x80) >> 6)) * (int)
                    (((a & 0x7f) << 8) + b))
#endif

#define BDS_LEN(bds)             ((int) ((bds[0]<<16)+(bds[1]<<8)+bds[2]))
#define BDS_Flag(bds)            (bds[3])
...
... etc
...

/* cnames_file.c */

/* search order for parameter names
 *
 * #define P_TABLE_FIRST
 * look at external parameter table first
 *
 * otherwise use builtin NCEP-2 or ECMWF-160 first
 */
/* #define P_TABLE_FIRST */

/* search order for external parameter table
 * 1) environment variable GRIBTAB
 * 2) environment variable GRIBtab
 * 3) the file 'GRIBtab' in current directory
 */

/* cnames.c */
/* then default values */
char *k5toa(unsigned char *pds);
char *k5_comments(unsigned char *pds);
int setup_user_table(int center, int subcenter, int ptable);

struct ParmTable {
```

```
    char *name, *comment;
};

/* version 1.4.1 of GRIB headers  w. ebisuzaki */
/* this version is incomplete */

#ifndef INT3
#define INT3(a,b,c) ((1-(int) ((unsigned) (a & 0x80) >> 6)) * (int)
                    (((a & 127) << 16)+(b<<8)+c))
#endif
#ifndef INT2
#define INT2(a,b)   ((1-(int) ((unsigned) (a & 0x80) >> 6)) * (int)
                    (((a & 127) << 8) + b))
#endif

#ifndef UINT3
#define UINT3(a,b,c) ((int) ((a << 16) + (b << 8) + (c)))
#endif

#ifndef UINT2
#define UINT2(a,b) ((int) ((a << 8) + (b)))
#endif

#define GDS_Len1(gds)          (gds[0])
#define GDS_Len2(gds)          (gds[1])
#define GDS_Len3(gds)          (gds[2])
#define GDS_LEN(gds)           ((int) ((gds[0]<<16)+(gds[1]<<8)+gds[2]))
...
... etc
...
#define GDS_RotLL_RotAng(gds)   ibm2flt(&(gds[38]))

/* index of NV and PV */
#define GDS_PV(gds)          ((gds[3] == 0) ? -1   : (int) gds[4] - 1)
#define GDS_PL(gds)          ((gds[4] == 255) ? -1 : (int) gds[3] * 4
                               + (int) gds[4] - 1)

enum Def_NCEP_Table {rean, opn, rean_nowarn, opn_nowarn};

unsigned char *seek_GRIB(FILE *file, long *pos, long *len_GRIB,
        unsigned char *buffer, unsigned int buf_len);

int read_GRIB(FILE *file, long pos, long len_GRIB, unsigned char *buffer);

double ibm2flt(unsigned char *ibm);

void BDS_unpack(float *flt, unsigned char *bits, unsigned char *bitmap,
        int n_bits, int n, double ref, double scale);

double int_power(double x, int y);

int flt2ieee(float x, unsigned char *ieee);

int wrtieee(float *array, int n, int header, FILE *output);
int wrtieee_header(unsigned int n, FILE *output);
```

```
void levels(int, int);

void PDStimes(int time_range, int p1, int p2, int time_unit);

int missing_points(unsigned char *bitmap, int n);

void EC_ext(unsigned char *pds, char *prefix, char *suffix);

int GDS_grid(unsigned char *gds, int *nx, int *ny, long int *nxny);
void GDS_prt_thin_lon(unsigned char *gds);

int PDS_date(unsigned char *pds, int option, int verf_time);

int add_time(int *year, int *month, int *day, int *hour, int dtime, int
unit);

int verf_time(unsigned char *pds, int *year, int *month, int *day, int
*hour);

void print_pds(unsigned char *pds, int print_PDS, int print_PDS10, int
verbose);
void print_gds(unsigned char *gds, int print_GDS, int print_GDS10, int
verbose);

void ensemble(unsigned char *pds, int mode);
/* version 3.4 of GRIB headers  w. ebisuzaki */
/* this version is incomplete */

#ifndef INT2
#define INT2(a,b)   ((1-(int) ((unsigned) (a & 0x80) >> 6)) * (int)
                    (((a & 0x7f) << 8) + b))
#endif

#define PDS_Len1(pds)          (pds[0])
...
... etc
...
#define PDS_NcepFcstProd(pds)   (pds[43])

#define VERSION "v1.6.2.5 (5-08-98) Wesley Ebisuzaki"

#define CHECK_GRIB

/*
 * WGRIB.c extract/inventory GRIB records
 *
 *                              Wesley Ebisuzaki
 *
 * 11/94 - v1.0
 ***
 *** other entries
 ***
 * 4/98  - v1.6.2.4: reanalysis id code: subcenter==0 && process==180
 *
 */
```

```
/*
 * MSEEK = I/O buffer size for seek_GRIB
 */

#define MSEEK 1024
#define BUFF_ALLOC0     40000

#ifndef min
#define min(a,b)  ((a) < (b) ? (a) : (b))
#define max(a,b)  ((a) < (b) ? (b) : (a))
#endif

#ifndef DEF_T62_NCEP_TABLE
#define DEF_T62_NCEP_TABLE     rean
#endif
enum Def_NCEP_Table def_ncep_table = DEF_T62_NCEP_TABLE;

int main(int argc, char **argv) {

unsigned char *buffer;
float *array;
double temp, rmin, rmax;
int i, nx, ny, file_arg;
long int len_GRIB, pos = 0, nxny, buffer_size, n_dump, count = 1;
unsigned char *msg, *pds, *gds, *bms, *bds, *pointer;
FILE *input, *dump_file = NULL;
char line[200];
enum {BINARY, TEXT, IEEE, GRIB, NONE} output_type = NONE;
enum {DUMP_ALL, DUMP_RECORD, DUMP_POSITION, DUMP_LIST, INVENTORY}
 mode = INVENTORY;
long int dump = -1;
int verbose = 0, append = 0, v_time = 0, year_4 = 0, output_PDS_GDS = 0;
int print_GDS = 0, print_GDS10 = 0, print_PDS = 0, print_PDS10 = 0;
char *dump_file_name = "dump", open_parm[3];
int header = 1, return_code = 0;

if (argc == 1) {
 fprintf(stderr, "\nPortable GRIB decoder for %s etc.\n",
     (def_ncep_table == opn_nowarn || def_ncep_table == opn) ?
     "NCEP Operations" : "NCEP/NCAR Reanalysis");
 fprintf(stderr, "   it slices, dices    %s\n", VERSION);
 fprintf(stderr, "   usage: %s [GRIB file] [options]\n\n", argv[0]);
 fprintf(stderr, "Inventory/diagnostic-output selections\n");
...
... etc
...
 fprintf(stderr, "   -o [file]    output file name, 'dump' is default\n");
     exit(8);
    }
    file_arg = 0;
    for (i = 1; i < argc; i++) {
     if (strcmp(argv[i],"-PDS") == 0) {
         print_PDS = 1;
         continue;
     }
     if (strcmp(argv[i],"-PDS10") == 0) {
```

```
            print_PDS10 = 1;
            continue;
        }
        if (strcmp(argv[i],"-GDS") == 0) {
            print_GDS = 1;
            continue;
        }
        if (strcmp(argv[i],"-GDS10") == 0) {
            print_GDS10 = 1;
            continue;
        }
        if (strcmp(argv[i],"-v") == 0) {
            verbose = 1;
            continue;
        }
        if (strcmp(argv[i],"-V") == 0) {
            verbose = 2;
            continue;
        }
        if (strcmp(argv[i],"-s") == 0) {
            verbose = -1;
            continue;
        }
        if (strcmp(argv[i],"-text") == 0) {
            output_type = TEXT;
            continue;
        }
        if (strcmp(argv[i],"-bin") == 0) {
            output_type = BINARY;
            continue;
        }
        if (strcmp(argv[i],"-ieee") == 0) {
            output_type = IEEE;
            continue;
        }
        if (strcmp(argv[i],"-GRIB") == 0) {
            output_type = GRIB;
            continue;
        }
        if (strcmp(argv[i],"-nh") == 0) {
            header = 0;
            continue;
        }
        if (strcmp(argv[i],"-h") == 0) {
            header = 1;
            continue;
        }
        if (strcmp(argv[i],"-append") == 0) {
            append = 1;
...
... etc
...
```